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S/020/61/137/002/010/020
B104/B212

J

Ionization in the terrestrial ...

However, these processes require a change of the conception about the ionization source in the upper atmosphere. According to these results the neutralization of the particles takes part in the ionosphere, mainly by transfer of the atomic ions into molecular ions and subsequent neutralization of the molecular ions. K. I. Gringauz and several western researchers have investigated the electron concentration above an altitude of 80 km, and the data are given in Table 1. The following differential equation for the vanishing of electrons is based on these data: $dn_e/dt = \alpha n_e n_2^+ = \alpha n_2^+ n_p / (n_1^+ + n_2^+)$. Therefore, there are recombination processes of higher intensity at these altitudes as has been assumed in the past. From this it follows also that much stronger

ionizing rays (10-100 erg/cm² sec) are found to exist than has been assumed in the past, in order to conserve the high degree of ionization. The newest data about the short wave spectrum of solar radiation have been studied in this connection. In a range of 1200-83.9 Å, 150 new lines have been found, the strongest one is a He II line with $\lambda = 304$ Å. For these lines an intensity of 15 erg/cm² sec has been calculated on the

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Ionization in the terrestrial ...

earth. This value is incorrect and due to estimations of the effective absorption cross section of the terrestrial atmosphere other authors have estimated that at a zenith angle of 79.5° these lines will be reduced to one eighteenth. Based on known data a new estimation of the intensity has been done and the value found is $I_0 = 1.2 \text{ erg/cm}^2 \text{ sec.}$

The results found with these two lines in two separate tests agree very well. The effective absorption cross section obtained for this line is

$1-1.5 \cdot 10^{-17} \text{ cm.}$ this also agrees well with data of other authors.

Finally, the difficulties for calibration of measuring instruments is mentioned, which are used for rocket tests. One of the surest ways to correct data obtained, is seen in comparing data of ultraviolet solar radiation, which have their origin in the corona and the transition zone between corona and photosphere, with those of other spectral regions.

Then, the author talks about a model which he had constructed earlier (Ref. 30: G. S. Ivanov-Kholodnyy, G. M. Nikol'skiy, Astr. Zhurn., 39, 65 (1961)) and which is based on newest data obtained with rockets. This model is very sensitive to the intensity of short wave emission, and it

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Ionization in the terrestrial ...

confirms the correctness of the estimations mentioned earlier. Therefore, it can be said that the ultraviolet solar radiation is about $30 \text{ erg/cm}^2 \text{ sec}$ ($5 \cdot 10^{11}$ quanta/ $\text{cm}^2 \text{ sec}$) at the boundary of the earth's atmosphere. The main process of the neutralization in the ionosphere is a dissociative recombination of the molecules, the atomic ions change over into molecular ions. In a column of the atmosphere with 1 cm^2 cross section about $3 \cdot 10^{11}$ - $3 \cdot 10^{12}$ recombination and ionization processes will take place. There are 1 table and 30 references: 12 Soviet-bloc and 18 non-Soviet-bloc.

ASSOCIATION: Institut prikladnoy geofiziki Akademii nauk SSSR
(Institute of Applied Geophysics, Academy of Sciences USSR)

PRESENTED: November 10, 1960, by Ye. K. Fedorov, Academician

SUBMITTED: October 20, 1960

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29116

S/020/61/140/005/012/022
B104/B102

11.1530
AUTHORS:

Ivanov-Kholodnyy, G. S., and Antonova, L. A.

TITLE:

Ionization of the nocturnal ionosphere (corpuscular hypothesis)

PERIODICAL:

Akademiya nauk SSSR. Doklady, v. 140, no. 5, 1961,
1062 - 1065

TEXT: In 1957, V. I. Krasovskiy (Priroda, no. 5, 55 (1957)) assumed charged particles as sources of ionization of the nocturnal ionosphere. R. L. Smith, R. A. Helliwell, I. W. Yabroff (J. Geophys. Res., 65, 815 (1960)) and B. J. O'Brien, J. A. Van Allen et al. (J. Geophys. Res., 65, 2583 (1960)) obtained new proofs for the existence of electron beams in the upper atmosphere. Assuming that, during the night, ionization in the ionosphere is caused by an electron particle flux, the authors calculated the particle energy. Equilibrium between generation and recombination of ions was assumed. Using data of V. V. Mikhnevich, B. S. Danilin et al. (Sborn. Iskusstvennyye sputniki Zemli, no. 3, 84 (1959)) about density of atmosphere, and of A. D. Danilov (Sborn. Iskusstvennyye

Card 1/2

IVANOV-KHOLODNY, G. S.

"On the Rate of Ionization and Recombination Processes in the Ionization Processes in the Earth Atmosphere"

Soviet Papers Presented at Plenary Meetings of Committee on Space Research (COSPAR) and Third International Space Science Symposium, Washington, D. C., 23 Apr - 9 May 62.

IVANOV-KHOLODNY, G. S.

" The role of trapped particles in auroral bombardment"
Report to be submitted at the IAU and IUGG Symposium on
Theoretical Interpretation of Upper Atmosphere Emissions,
Paris, France, 25-29 June 1962

1. Institute of Applied Geophysics, Academy of Sciences USSR, Moscow.

IVANOV-KHOLODNYI, G. S.

"Ionization of the upper atmosphere by solar shortwave radiation"

report to be submitted for the 13th Intl. Astronautical Congress, IAF,
Varna, Bulgaria, 23-29 Sep 1962.

S/203/62/002/003/001/021
I023/I250

AUTHOR: Ivanov-Kholodnyy, G.S.

TITLE: Intensity of Sun's shortwave radiation and the speed of ionization and recombination processes in the ionosphere (Review)

PERIODICAL: Geomagnetizm i Aeronomiya, v.2, no.3, 1962, 377-406

TEXT: The review deals mainly with interpretation of new data, obtained with rockets and artificial satellites. It is based on Western and Soviet literature up to 1962. Three subjects are discussed. 1) the total energy and the spectrum of Sun's ionizing radiation, where the subheadings are: Determination of the total shortwave ($\lambda \leq 1100\text{\AA}$) flux S from ionospheric data. Determination of S from astrophysical data. Rocket data on Sun's shortwave radiation. The interpretation of the rocket data. Variation of the radiation intensity and the active areas on the Sun. 2) The ionic composition of the atmosphere: Abundance of molecular ions in the ionosphere. The hypothesis of dissociative recombination in the ionosphere.

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S/203/62/002/003,001/021
I023/I250

Intensity of Sun's shortwave...

Investigation of the reaction of dissociative recombination in the laboratory. The effective coefficient α' of recombination in the ionosphere (theory). Continuation of the processes of dissociative recombination in the ionosphere. The effective coefficient α' of recombination in the ionosphere (experiment). The power of the energy sources in the upper atmosphere. 3) Corpuscular currents in the ionosphere. The conclusions are: the new rocket data on the intensity and spectrum of Sun's shortwave radiation, its distribution on the Sun's disk, the ionic composition and corpuscular radiations in the ionosphere contradict the existing ideas about the rates of recombination and ionizing processes in the ionosphere. The conclusions about the high intensity of ionization and recombination processes in the ionosphere are partly confirmed by sea level ionospheric observations. There are 4 tables, 3 figures and 174 references.

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43155
S/203/62/002/003/003/021
I023/I250

AUTHOR: Ivanov-Kholodnyy, G.S. and Nikol'skiy, G.M.
TITLE: Identification of Sun's radiation lines in the short-wave region of the spectrum ($\lambda \leq 1100\text{\AA}$)

PERIODICAL: Geomagnetizm i Aeronomiya, v.2, no.3, 1962, 425-442

TEXT: Out of ~ 225 lines of Sun's shortwave radiation (60 to 1100\AA) obtained by means of rockets, 180 lines are identified in this work. The intensity of the lines is taken into account. A critical analysis of former identifications is given. In the spectral energy distribution Maxima in the following wavelength regions were found: $60-100$ (corona), $200-450$, $550-650$, $750-850$, $950-1050\text{\AA}$. A minimum estimate of the total energy of the line radiation ($\lambda \leq 1100\text{\AA}$) is $15 \text{ erg/cm}^2 \text{ sec}$ at the Earth. Half of this energy is concentrated in the region of $200-400 \text{\AA}$. The relative content of nitrogen on the Sun is $\text{N/H} = 3 \times 10^{-5}$. The identification of the lines was done by comparison with a list of 540 spectral lines, in the range $18-1100\text{\AA}$, taken from a work by the same authors: Astron.Zh.1961, 38, 828. The

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S/203/62/002/003/003/021
I023/1250

Identification of Sun's radiation...

intensities of the lines in this list exceed $3 \times 10^{-4} - 10^{-3}$ erg/cm² sec. There is 1 table, 4 figures, 19 references. ✓

ASSOCIATION: Institut prikladnoy geofiziki Akademii nauk SSSR,
Institut Zemnogo magnetizma, ionosfery i rasprostra-
neniya radiovoln Akademii nauk SSSR (Institute of
Applied Geophysics, Academy of Sciences of the USSR;
Institute of Terrestrial Magnetism, Ionosphere and
Radiowave Propagation, Academy of Sciences of the USSR)

SUBMITTED: September 2, 1961

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IVANOV, KHOLODNYI, G.S.

Ionization of the upper atmosphere with short-wave solar radiation.
Geomag. 1 aer. 2 no. 4:674-687 JI-Ag '62. (MIRA 15:10)

1. Institut prikladnoy geofiziki AN SSSR.
(Solar radiation) (Ionosphere)

IVANOV-KHOLODNYI, G.S., kand.fiz.-matem.nauk

Symposium on the theoretical interpretation of the emissions of
the upper atmosphere. Vest. AN SSSR 32 no.12:78-79 D '62.
(MIRA 15:12)
(Atmosphere, Upper—Congresses)

ACCESSION NR: AT3012812

S/2961/63/000/005/0154/0170

AUTHOR: Ivanov-Kholodny*y, G. S.

TITLE: Role and source of corpuscles observed in the ionosphere and in aurorae

SOURCE: AN SSSR. Mezhdovedomst. geofizich. komitet. 7 razdel program. MGG: Kosmicheskiye luchy. Sb. statey, no. 5, 1963, 154-170

TOPIC TAGS: ionosphere, aurora, solar corpuscle, electron flux, corpuscle acceleration, radiation belt, nighttime ionization

ABSTRACT: Various studies of the electron flux penetrating sufficiently deep in the earth's atmosphere are reviewed. Experimental data are cited on the intensity and energy spectrum of the particles propagating through the ionosphere and aurorae. The experimental data cover the connection between the radiation belts and the aurorae, the corpuscles in the aurorae in the ionosphere, the measure-

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ACCESSION NR: AT3012812

ment of the electron flux in aurorae with rockets and satellites, the acceleration of the corpuscles in the atmosphere, x-rays generated in the upper atmosphere, intensity of corpuscular streams, captured particles as sources of auroras, and the mechanisms whereby the particles spill out of the radiation belts. It is shown that the electron flux observed at 100--1,000 km should carry an energy of 0.1--1 erg/cm² to the ionosphere in order to maintain nighttime ionization and to heat the atmosphere. Some indirect data show that the electrons originate in the ionosphere and not in the radiation belts and that the latter are probably the result of the acceleration mechanisms whereby some of the particles get into the trapping trajectory. The auroras are possibly fluxes of soft electrons which rapidly lose their energy and excite the polar glow of the ionosphere, being produced at the top of the atmosphere in relatively low altitudes. The acceleration of the electrons may be due to geomagnetic variations at the expense of the energy of the earth's magnetic field, but the specific mechanism of particle acceleration

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ACCESSION NR: AT3012812

and their source is not yet clear. Data on this are still inconclusive. Orig. art. has: 1 figure.

ASSOCIATION: None

SUBMITTED: 00

DATE ACQ: 22Oct63

ENCL: 00

SUB CODE: PH, AS

NO REF SOV: 023

OTHER: 076

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SWT(1)/EPP(n)-2/BDS AFFTC/ASD/ESD-3/SSD PR-1
ACCESSION NO. APPROX 861 3/2560/45/000/015/0071/0080

Author: Karachuk, T. V.; Arkhangel'skaya, V. A.; Lyubov-Kholodnyy, G. S.;
Mavlov, I. A.; Chudakov, A. I.

TITLE: Measurement of x- and ultraviolet radiation with thermoluminescent phosphorus CaSO_4 (Mn)

SOURCE: AN SSSR. Tekhn. sputnik Zemli, no. 15, 1963, 71-80

TOPIC TAGS: rocket investigation, solar ultraviolet radiation, solar radiation, thermoluminescent phosphorus, solar eclipse investigation, ionospheric penetrating radiation

ABSTRACT: A device based on the principle of recording short-wave radiation with CaSO_4 (Mn) thermoluminescent phosphorus has been developed by the Institut prikladnoy geofiziki (Institute of Applied Geophysics) to measure solar ultraviolet and x-radiation. The phosphorus stores up energy during irradiation and then emits it in the visible region of the spectrum when heated. The brightness of the emission, as well as the total energy (light total), is proportional within broad limits to the energy of irradiation. It has been established that CaSO_4 (Mn) phosphorus is sensitive only to emission with wavelengths from 1 to 1500 Å and

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does not become saturated during irradiation intensity changes of even five orders. The phosphorus was used on a rocket to measure the intensity of penetrating radiation in the lower part of the ionosphere during the solar eclipse of 15 February 1961. Unlike the use of thermoluminescent phosphorus in rocket measurements in the U. S. A., where the phosphorus is reemitted in the laboratory after retrieval of the container, the phosphorus used in the test of 15 February 1961 was reemitted during the flight, thus reducing the error. Calibration measurement was performed in flight with the use of a constant-action etalon sample. The measurement error in determining the energy of UV radiation was 55%; for x-radiation it was 30%. The intensity of radiation at a height of 95 km was about 7×10^7 quanta $\text{cm}^{-2} \text{sec}^{-1}$, while at a height of 67 km it was 500 times lower. This radiation exceeds the theoretically computed maximal solar x-radiation by 50 to 100 times. "The authors thank S. V. Repolevskiy for help in developing the device and carrying out tests and also T. A. Kreshnovaya for preparing calibrated luminescent substances." Orig. art. has: 4 tables, 5 figures, and 3 formulas.

ASSOCIATION: none

SUBMITTED: 10May62

DATE ACQ: 29Jul63

INCL: 00

SUB CODE: AS
 Card 2/2

NO REF SOV: 014

OTHER: 007

KAZACHEVSKAYA, T.V.; IVANOV-KHOLODNYI, G.S.

Interpretation of the data of rocket measurements in the upper
atmosphere made by means of thermoluminescent phosphor. Isk.
sput.Zem. no.15:81-84 '63. (MIRA 16:4)
(Atmosphere, Upper--Rocket observations)

DANILOV, A.D.; IVANOV-KHOLODNYI, G.S.

Experimental data on the strength of energy sources in the ionosphere. Geomag. i aer. 3 no.5:850-857 S-0 '63. (MIRA 16:11)

1. Institut prikladnoy geofiziki AN SSSR.

ANTONOV VA, I.A.; IVANOV-KHOLODNIY, G.N.; MALANINA, N.D.; MEDVEDEV, V.S.

Measurement of fluxes of soft electrons in the upper atmosphere
by means of a secondary-electron multiplier. Kozm. issl. 3 no.1:
82-88 Ja-F '65. (MIRA 18:2)

L 36809-66 EWT(1)/FCC GW SOURCE CODE: UR/2831/65/000/014/0005/0008

ACC NR: AT6023722

AUTHOR: Ivanov-Kholodnyy, G. S.; Nikol'skiy, G. M.

ORG: none

TITLE: Short-wave solar radiation, structure of the solar atmosphere and the ionosphere

SOURCE: AN SSSR. Mezhdudomstvennyy geofizicheskiy komitet. V razdel programmy

MGG: Ionosfera. Sbornik statey, no. 14, 1965. Ionosfernyye issledovaniya, 5-8

TOPIC TAGS: solar spectrum, F layer, solar corona, chromosphere, solar UV radiation, solar cycle, atmospheric ionization, ionosphere, solar activity, solar atmosphere

ABSTRACT: An examination has been made of 225 spectral lines obtained from various spectrograms in the short ultraviolet range to identify them with known lines. Such identification requires the knowledge of physical conditions in the solar corona and the intermediate space between the corona and the chromosphere. A theory of ionization in the solar atmosphere was developed, and, on the basis of this theory, lines were computed which must appear in the solar ultraviolet range. From spectrograms 180 lines were identified with lines computed theoretically. Fe, Si, and hydrogen lines were the brightest. A model of active regions on the sun was composed

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L 36809-66

ACC NR: AT6023722

to explain geophysical phenomena. The brightness of the active regions in ultraviolet light was found to be 30 times that of the quiet areas. The intensity of ultraviolet radiation varies from day to day and depends upon the phase of the solar activity cycle. The total flux of solar ionizing radiation was determined, and during maximum solar activity, it was equal to $15 \text{ erg/cm}^2 \cdot \text{sec}$. New data on the short-wave spectrum (0—1100 Å) were used for computing the speed of ionization in the atmosphere. A model of the ionosphere for the heights of 100—800 km was developed for various moments in the day. The maximum ion formation occurs in the F1 layer during the day and in the F2 layer at night. Variations of ion formation are great in the F1 layer and small in the F2 layer. The asymmetry in the density of the upper atmosphere at noon causes an asymmetry in changes of the speed of ion formation and the number of electrons. This phenomenon contradicts Appleton's method for determining the recombination coefficient. New data require a change in earlier concepts of the processes of ionization and recombination in the ionosphere. Orig. art. has: 1 [EG]

SUB CODE: 03/ SUBM DATE: none/ ORIG REF: 009/ OTH REF: 001/ ATD PRESS: 5036

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L 38452-66 EWT(1)/FCC GW
ACC NR: AT6023723

SOURCE CODE: UR/2831/65/000/014/0009/0012

AUTHOR: Antonova, L. A.; Ivanov-Kholodnyy, G. S.

ORG: none

TITLE: Corpuscular ionization hypothesis in the nocturnal ionosphere

SOURCE: AN SSSR. Mezhdudomstvennyy geofizicheskiy komitet. V razdel programmy
MGG: Ionosfera. Sbornik statey, no. 14, 1965. Ionosfernyye issledovaniya, 9-12

TOPIC TAGS: ~~electron concentration~~, ionosphere, solar eclipse, satellite measurement,
hard electron, electron flux, effective recombination coefficient, ~~corpuscular stream~~
radiation belt, solar corpuscular radiation, ionospheric electron density

ABSTRACT: The electron concentration in the lower ionosphere diminishes after sun-
set, but it does not disappear and maintains a constant level during the night. An
analogous phenomenon is observed during solar eclipse. The source of continued
ionization may be assumed to be charged particles in the upper atmosphere. Rocket
and satellite measurements revealed electron fluxes at various altitudes above the
Earth. Hard, high-energy electrons were measured which were peculiar in their
sporadic appearance and the dependence of their intensity and spectrum upon the
latitude. Maximum radiation at 100-km altitude was found to be in the auroral zone.
The authors developed a hypothesis that nocturnal ionization in the F2 layer is
caused by electron fluxes which penetrate the atmosphere deeply. The effective
energy and the energy spectrum in the F2 layer were computed. The radiation intensity
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L 38452-66

ACC NR: AT6023723

was found to be proportional to the effective coefficient of recombination. The intensity of the corpuscular stream was determined from a given value of the dissociative recombination coefficient. The solar corpuscular stream differs from those in the radiation belts and in the ionosphere. The penetration of the solar corpuscular stream into the ionosphere is hindered by the geomagnetic field. Corpuscular streams from radiation belts are also unable to reach the ionosphere. A comparison of x-radiation at 100-km altitude measured by balloons with the electron flux measured by rockets at the same altitude, leads to the conclusion that a great quantity of electrons exists in the upper atmosphere which may be revealed by bremsstrahlung when it penetrates dense atmospheric layers. [EG]

SUB CODE: 04/ SUBM DATE: none/ ORIG REF: 011/ OTH REF: 004/ ATD PRESS: 5042

Card 2/2

"APPROVED FOR RELEASE: 08/10/2001

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Card 3/3 /

APPROVED FOR RELEASE: 08/10/2001

CIA-RDP86-00513R000619210017-4"

KAZACHEVSKAYA, T.V.; IVANOV-KHOLODNYI, G.S.

Rocket data on the behavior of the electron concentration in the ionosphere at altitudes of 100 to 300 km. Part 1. Geomag. i aer. 5 no.6:1009-1024 N-D '65. (MIRA 19:1)

1. Institut prikladnoy geofiziki. Submitted January 13, 1965.

L 23190-66 ENT(1)/FCC/EMA(h) GW

ACC NR: AP6006655

SOURCE CODE: UR/0203/66/004/001/0027/0036

AUTHORS: Kazachevskaya, T. V.; Ivanov-Kholodnyy, G. S.

ORG: Institute of Applied Geophysics (Institut prikladnoy geofiziki)

TITLE: Rocket data on electron concentration in the ionosphere at heights of 100--300 km. 2

SOURCE: Geomagnetizm i aeronomiya, v. 6, no. 1, 1966, 27-36

TOPIC TAGS: ionospheric electron density, F layer, E layer, solar activity, atmospheric stratification

ABSTRACT: The first part of this article dealt with data for daylight hours. In this part, the behavior of the ionosphere and variations in heights of the E and F layers at night are examined on the basis of rocket measurements of electron concentration. At heights of 125--160 km, a decrease in electron concentration after sunset is characterized by an effective recombination coefficient of $(0.35-1) \cdot 10^{-7} \text{ cm}^3/\text{sec}$, which agrees with the coefficient for daylight hours. In the E layer at a height of 110--120 km, the electron concentration decreases much more

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NUM: 550.380.2

L 23190-66

ACC NR: AP6006655

slowly at night, and the effective recombination coefficient is 10^{-8} cm³/sec or less. It is believed that the E layer at night is maintained by corpuscular sources of ionization, gradually weakening after sunset. The intensity of these sources declines tenfold and a hundredfold during low periods of solar activity. The height of the base of the E layer decreases with increase in geomagnetic activity, and this depends on the season. It is less in winter and summer than in spring or fall. The height of the F layer declines during periods of low solar activity, by day and by night, and this too depends on the season. It is greater in summer and fall than in winter or spring. The height of the F layer is greater at night than during the day. A sunrise-sunset effect has been observed. The height of the F layer increases sharply after sunrise and before sundown. Orig. art. has: 3 figures, 1 table, and 4 formulas.

SUB CODE: 04/ SUBM DATE: 13Jan65/ ORIG REF: 006/

OTH REF: 043

Card 2/2 *ge*

L 44710-66 EWT(1)/EWT(m)/FCC GW

SOURCE CODE: UR/0293/66/004/003/0439/0452

ACC NR: AP6030739

AUTHOR: Ivanov-Kholodnyy, G. S.

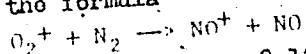
ORG: none

TITLE: Variations of the ion contents in the atmosphere at heights of 100 to 200 km

SOURCE: Kosmicheskiye issledovaniya, v. 4, no. 3, 1966, 439-452

TOPIC TAGS: atmospheric ion concentration, charged particle, radioactive decay, atmospheric ionization, ionospheric electron density, solar radiation intensity, solar radiation effect, mass spectroscopy, solar activity, spaceborne atmospheric observation

ABSTRACT: Electron and ion concentrations in upper atmospheric layers were investigated theoretically, and the theoretical results were compared with experimental data. Formulas are given for determining the fundamental processes in the formation of charged particles in the ionosphere. The formation of NO^+ ions after the decay of O_2^+ occurs according to the formula



if the speed of the reaction is less than $2 \cdot 10^{-13} \text{ cm}^3 \text{ sec}^{-1}$. This reaction must be taken into account in observations at night and at heights of less than 130 km when the balance of concentration of ions NO^+ and O_2^+ is studied. Formulas determining

UDC: 551.535.4

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ACC NR: AP6030739

the formation of NO^+ and O_2^+ are

$$[\text{NO}^+] = \{[\text{N}_2][\text{O}^+] \gamma_{\text{NO}^+} + [\text{O}_2^+][\text{N}_2] \gamma_1\} (\alpha_{\text{NO}^+} n_e)^{-1},$$

$$[\text{O}_2^+] = \frac{[\text{O}_2][\text{O}^+] \gamma_{\text{O}_2^+} + I_3[\text{O}_2]}{(\alpha_{\text{O}_2^+} n_e + [\text{N}_2] \gamma_1)},$$

where α and γ are constants of the rate of formation and I denotes the ionization speed. The total speed of ion formation depends upon the ionizing intensity of solar radiation on the fundamental elements of the atmosphere, O_2 and N_2 . The electron concentration N_e and ion concentrations of $[\text{NO}^+]$ and $[\text{O}_2^+]$ depend upon the O^+ ion concentration in the atmosphere according to the formula

$$n_e = AN \frac{[\text{O}^+]}{n_e} \left(1 - \frac{[\text{O}^+]}{n_e}\right)^{-1},$$

where A is an independent coefficient and N is the number of particles. The concentration of molecular ions and the O^+ ion in the atmosphere has a mirror character, so that when $[\text{O}^+]/N_e$ increases, the ratios $[\text{NO}^+]/N_e$ and $[\text{O}_2^+]/N_e$ decrease. A table in the original article shows the ion concentration at various heights and its dependence upon the intensity of solar radiation.

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L 44710-66

ACC NR: AP6030739

Experimental investigations were carried out by rocket-borne mass-spectrometric measurements. Rockets were launched in the mornings and evenings at solar zenithal distances between 50° and 90° . Four launches took place after sunset. Measurements were carried out at various phases of the solar activity cycle at heights from 160 to 200 km. Fig. 1 shows the rates of the variation of $\log NO^+/O_2^+$, relative to the height and solar-activity phase.

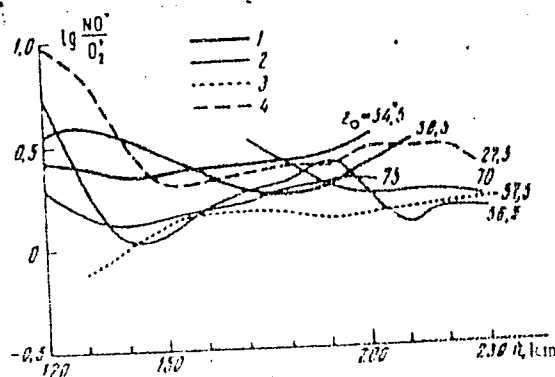


Fig. 1. Variations of ion concentration

1 - High activity; 2 - middle activity;
3 - low activity; 4 - magnetic perturbations.

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ACC NR: AP6030739

A sharp change in ion concentration at the height of 130 to 140 km may be caused by the reaction $O_2^+ + N_2 \rightarrow NO^+ + NO$ with the constant reaction speed equal to $(3 \text{ to } 10) \times 10^{-14} \text{ cm}^3 \text{ sec}^{-1}$. When the solar zenithal distance changes from 90° to 55° , the ratio $[O^+]/N_e$ increases, and the concentration of molecular ions decreases. The ratio $[NO^+]/[O_2^+]$ is constant during the daytime at heights from 140 to 200 km. Orig. art. has: 5 figures, 35 formulas and 3 tables. [FSB: v. 2, no. 3]

SUB CODE: 04, 03, 07 / SUBM DATE: 31May65 / ORIG REF: 012 / OTH REF: 011

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Card 4/4

L 07364-62 FSS-2/EWT(1)/EEC(k)-2 TT/GW

ACC NR: AP6033271

SOURCE CODE: UR/0020/66/170/004/0831/0834

AUTHOR: Ivanov-kholodnyy, G. S.

ORG: Applied Geophysics Institute (Institut prikladnoy geofiziki)

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B

TITLE: Anomaly in the composition of generated ions and certain phenomena in the lower atmosphere

SOURCE: AN SSSR. Doklady, v. 170, no. 4, 1966, 831-834

TOPIC TAGS: lower atmosphere, atmospheric ionization, atmospheric recombination, data analysis, atmospheric ion recombination

ABSTRACT: The authors analyze the rate of formation of $[NO^+]$ and $[O_2^+]$ ions and the effective coefficient of ion recombination α' in the lower atmosphere at altitudes ranging from 100 to 200km. By analyzing the previous data on the M-20 computer, it was established that the ratio $[NO^+]/[O_2^+]$ decreases with decreasing altitude (in the range between 200 and 150km) and increasing zenith angle (in the range 60—90°). The increasing solar activity causes the $[NO^+]/[O_2^+]$ ratio to increase, but its variation with altitude and the zenith angle becomes less pronounced. However, at altitudes below 150km the ratio $[NO^+]/[O_2^+]$ increases with increasing zenith angle and decreasing solar activity. By analyzing the most reliable mass spectrometer data, it was established that the variation of α' as a function of the solar activity,

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UDC: 550.388.2

ACC NR:

AP6033271

altitude, and the zenith angle is opposite to the variation of $[NO^+]/[O_2^+]$. The paper was presented by Academician Ye. K. Fedorov on 22 December 1966. Orig. art. has: 5 formulas and 3 figures.

SUB CODE: 04/ SUBM DATE: 15Dec65/ ORIG REF: 006/ OTH REF: 003 /
ATD PRESS: 5101

Card 2/2 afa

ACC NR: AR6035546

SOURCE CODE: UR/0269/66/000/010/0058/0058

AUTHOR: Ivanov-Kholodnyy, G. S.; Nikol'skiy, G. M.

TITLE: Solar short wave radiation, structure of the solar atmosphere and ionosphere

SOURCE: Ref. zh. Astronomiya, Abs. 10.51.418

REF SOURCE: Sb. Ionofern. issledovaniya, No. 14. M., Nauka, 1965, 5-8

TOPIC TAGS: solar atmosphere, radio wave, solar ionosphere, solar short radio wave

ABSTRACT: The problem of studying the spectral distribution of the intensity of solar short wave radiation is discussed. Articles dealing with the subject are briefly reviewed. The rate of ion formation in the upper atmosphere is determined for various periods of the day. Bibliography has 10 titles. [Translation of abstract]
[DW]

SUB CODE: 03/

Card 1/1

UDC: 523.7:525.23

ACC NR: AP6011710

SOURCE CODE: UR/0203/66/006/092/0382/0355

AUTHOR: Ivanov-Kholodnyy, G. S.

ORG: Institute of Applied Geophysics (Institut prikladnoy geofiziki)

TITLE: Intensity of ion formation at altitudes of 100--300 km

SOURCE: Geomagnetizm i aeronomiya, v. 6, no. 2, 1966, 382-385

TOPIC TAGS: upper atmosphere, atmospheric ion, solar radiation

ABSTRACT: New data which were recently obtained on the spectrum of the ionizing radiation of the sun I_{λ} , effective cross sections of absorption σ and ionization σ^1 , and the composition of the upper atmosphere permitted the author to substantially refine previous estimates of the rate of ion formation q with an accuracy up to 0.5--1 order of magnitude, which is important in solving the problem of energetics of the upper atmosphere and the nature of the ionization sources in the ionosphere. The effect of the inaccuracy or divergence of data on σ , σ^1 , and I_{λ} on the results of calculating q is investigated. The use of the average values of the initial data gives a value of q with an error within the limits of about 1.5 for low solar activity and about 2 for high solar activity. This permits using the results of calculating q for eliciting the mechanism of ionization in the upper atmosphere at various altitudes. The data on $q(h)$ are important also for constructing a model of the diurnal variation of the neutral atmosphere, since the effect of heating of the upper atmosphere by solar radiation is

Card 1/2

UDC 550.38.8.2

ACC NR: AP7002202

SOURCE CODE: UR/0203/66/006/006/1114/1116

AUTHOR: Korsunova, L. P.; Mishin, V. M.; Ivanov-Kholodnyy, G.S.
Kazachevskaya, T.B.-Kazachevskaya, T.V.

ORG: Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave
Propagation, SO AN SSSR (Institut zemnogo magnetizma, ionosfery
i rasprostraneniya radiovaln SO AN SSSR). Applied Physico Institute,
GUGMS (Institut prikladnoy fiziky GUGMS)

TITLE: Relationship between the electron concentration at altitudes
of 100 and 110 km and disturbances in the Earth's magnetic field

SOURCE: Geomagnetizm i aeronomiya, v. 6, no. 6, 1966, 1114-1116

TOPIC TAGS: ionosphere, ionospheric electron density, *earth magnetic field*

ABSTRACT: The effect of magnetic activity on electron concentration n_e at altitudes
of 100 and 110 km in the lower region of the E layer was investigated.
Values of n_e were taken during 36 rocket-borne experiments conducted in the
period 1947-1963 at middle latitudes. The degree of disturbance of the
Earth's magnetic field was estimated from 3-hour values of K-indices. It
was found that the electron concentration at midlatitudes increased as

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UDC: 550.388.2:550.385

ACC NR: AP7002202

magnetic activity increased (i.e., for $K = 3-5$ the electron concentration increased not less than 1.5 times at 110 km, and not less than 2 times at 100 km. It is postulated that for K73 corpuscular streams have an appreciable effect on electron concentration in the lower regions of the ionospheric E layer at midlatitudes.

[WA-03]

SUB CODE: 04 ~~ED~~/ SUBM DATE: 22Mar66/ ORIG REF: 007/
 ATD PRESS: 5113

Card 2/2

L 1273-66 EWT(1)/FCC/EWA(h) GW/GS

ACCESSION NR: AT5023580

UR/0000/65/000/000/0184/0189

AUTHOR: Kazachevskaya, T. V.; Ivanov-Kholodnyy, G. S.

TITLE: Rocket data on the behavior of electron concentration in the ionosphere at altitudes of 100-300 km

SOURCE: Vsesoyuznaya konferentsiya po fizike kosmicheskogo prostranstva. Moscow, 1965. Issledovaniya kosmicheskogo prostranstva (Space research); trudy konferentsii. Moscow, Izd-vo Nauka, 1965, 184-189

TOPIC TAGS: ionosphere, ionospheric electron density, E layer, F layer

ABSTRACT: An attempt is made to construct a model for the variation in electron concentration n_e at altitudes of 100-300 km solely on the basis of direct sounding of the ionosphere by rockets. All data on rocket measurements of n_e are compared for various times of day and various seasons at altitudes of 100-130 km. The variation in $\log n_e$ is derived as a function of $\log f$, which characterizes the atmospheric air mass. This relationship is linear at nearly all altitudes below 200 km, i. e. $n_e \propto f^{-1}$, where l determines the rate of change in electron concentration at a given altitude during the day. The parameter $l > 0.5$ for nearly all altitudes, and is

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L 1273-66

ACCESSION NR: AT5023580

close to 0.5 only at altitudes of 120-130 km. This large value of l and its dependence on altitude is explained by variations in the energy of the solar radiation which ionizes the outer atmosphere of our planet (the ionosphere). A graph is given comparing empirical values of l with the theoretical value of the parameter m which determines the rate of change in ion formation at a given altitude during the day, i.e. $q \propto f^{-m}$. Minima are observed in both l and m in the 120-130 km altitude region. A comparison of these parameters for various seasons and various values of $\log f$ seems to confirm the hypothesis that variations in l are due to variations in ionizing solar radiation. Variations in the altitudes of the E and F regions are analyzed. It is found that the altitude of the E region depends on the season, and decreases with an increase in geomagnetic activity. There may be a connection between variations in the altitude of the E layer and variations in the density of the upper atmosphere in this region. The altitude of the F region depends on the season and decreases with a reduction in solar activity. The complex daily variations in the altitude of the F region are apparently caused both by variations in temperature and in the rate of ionization, as well as by changes in atmospheric composition. Orig. art. has: 4 figures. [14]

ASSOCIATION: none

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L 1273-66

ACCESSION NR: AT5023580

SUBMITTED: 02Sep65

NO REF SOV: 001

ENCL: 00

OTHER: 003

SUB CODE: ES

ATD PRESS: 4102-

Card ^{KC} 3/3

L 1277-66 EWA(h)/EWT(1)/FCC GW/GS

ACCESSION NR: AT5023587

UR/0000/65/000/000/0216/0219

AUTHOR: Ivanov-Kholodnyy, G. S.; Danilov, A. D.

TITLE: Variations in the ion composition of the atmosphere at altitudes of 100-200 km

SOURCE: Vsesoyuznaya konferentsiya po fizike kosmicheskogo prostranstva, Moscow, 1965. Issledovaniya kosmicheskogo prostranstva (Space research); trudy konferentsii. Moscow, Izd-vo Nauka, 1965, 216-219

TOPIC TAGS: ionosphere, ion concentration, mass spectrometry, diurnal variation, solar activity

ABSTRACT: Mass-spectrometric data are used for studying fluctuations in the ion concentration at altitudes of 100-200 km with respect to time of day and solar activity. Experimental graphs are given for the diurnal variation in relative concentrations O^+/n_e and NO^+/n_e . Theoretical analysis shows that NO^+/O_2^+ should be independent of altitude and solar zenith distance in the 140-180 km region when the composition and density of the atmosphere remain constant. Experimental observations confirm this relationship within a factor of 1.5. A table is given showing the

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L 1277-66

ACCESSION NR: AT5023587

relationships between ion concentration, intensity of ionizing radiation and atmospheric density in various regions of the ionosphere. In spite of the fact that the electron concentration and relative concentrations of O^+ ions are different functions of solar zenith distance at different levels of solar activity, absolute O^+ concentrations are not noticeably dependent on activity, which indicates a simultaneous change in both the intensity of ionizing radiation and the atmospheric density during the solar cycle. An analysis of the experimental data is used for a more precise determination of the ratio between the constants of fundamental ion reactions in the ionosphere:

$$\gamma_{NO^+}/\alpha_{NO^+} \approx 4 \cdot 10^{-4}; \quad \gamma_{O^+}/\alpha_{O^+} \approx 2 \cdot 10^{-4}.$$

Orig. art. has: 3 figures, 1 table.

[14]

ASSOCIATION: none

SUBMITTED: 02Sep65

ENCL: 00

SUB CODE: ES

NO REF SOV: 000

OTHER: 000

ATD PRESS: 402

Card 2/2

L 1712-66 EWT(1)/FCC/EWA(h) GW

ACCESSION NR: AP5021000

UR/0203/65/005/004/0705/0720
550.388.2

AUTHOR: Ivanov-Kholodnyy, G. S.

TITLE: The ionization mechanism in the lower ionosphere. Part I

SOURCE: Geomagnetizm i aeronomiya, v. 5, no. 4, 1965, 705-720

TOPIC TAGS: ionization measurement, solar x radiation, ionospheric electron density, ionospheric disturbance, D layer

ABSTRACT: The present paper is an attempt to study D layer ionization by starting from the most reliable existing data concerning the ionizing agents. The author began by determining the theoretical ionization at altitudes of 60-100 km from various degrees of activity of the quiet Sun and during solar flares. On the basis of these calculations and their comparison with the measured values of electron concentration n_e and the effective recombination coefficient α' , the following conclusions are reached: 1) Cosmic rays cause much stronger ionization than solar radiation at altitudes below 75 km during periods of minimum solar activity and below 65 km during the maximum. 2) Solar x-rays below 10-20 Å are the source of ionization only below 85-90 km, while higher altitudes are affected more by a combination of long-wave x-ray and UV (1000 Å) radiation. 3) At an altitude of

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L 1712-56

ACCESSION NR: AP5021000

75--90 km the electron concentration should, during a solar cycle, vary by 0.5--1 order of magnitude. 4) The ionization within the 70--85-km layer is difficult to explain by L_{α} solar radiation interaction. 5) Rocket and satellite data concerning x-rays from solar flares agree with the ionospheric n_0 and u' data during ionospheric perturbations. 6) In the 60--75 km region, the existence of a third sporadic ionization source must be assumed. Orig. art. has: 5 formulas, 4 figures, and 4 tables. [09]

ASSOCIATION: Institut prikladnoy geofiziki GUGMS (Institute of Applied Geophysics, GUGMS)

SUBMITTED: 25Aug64

ENCL: 00

SUB CODE: IS

NO REF SOV: 011

OTHER: 046

ATD PRESS: 4091

Card 2/2

IVANOV-MIROSLAVTSEV, Petr Ivanovich; SIDOROV, P.A., red.; ALEKSEYEVA, V.M.,
red.; PETROV, G.P., tekhn. red.

[New branches of the Chuvashian industry] Novye otrosli promyshlen-
nosti Chuvashii. Cheboksary, Chuvashskoe gos. izd-vo, 1960. 39 p.
(MIRA 14:7)

(Chuvashia—Industries)

ACC NR: AP6016845

SOURCE CODE: UR/0026/66/000/005/0040/0047

AUTHOR: Ivanov-Muromskiy, K. A.; Golovan', E. T.; Starinets, V. S.

ORG: none

TITLE: At the junction of cybernetics and psychology

SOURCE: Priroda, no. 5, 1966, 40-47

TOPIC TAGS: brain, cybernetics, electronic computer

ABSTRACT:

The simulation of human behavior is a new branch of study which has developed at the junction of cybernetics and psychology. Simulation of the functioning of human and animal brains can lead to improvement in electronic computers and to a deeper understanding of psychic activity. The reflections of an objective reality in a brain and in an automat can be studied as a simulation process, although the reflections are qualitatively different.

The basis for the normal existence of a living organism is its equilibration, i. e., its active accommodation to surrounding conditions. I. P. Pavlov formulated this as follows: "The magnificent complexity of the higher as well as the lower organisms holds only as long as the compound is precisely bounded and equilibrated internally and with the surrounding conditions." Thus, one should distinguish between internal equilibrium, which is intended to preserve homeo-

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ACC NR: AP6016845

stasis—the stability of the internal environment of an organism—and external equilibrium, which governs the selection of an optimum behavior. These are constantly flowing processes, the equilibrium being disrupted and reinstated over and over again.

Simulation in a living organism is an expression of the reflection of the overall feature of matter. The reflection process involves an interdependence between two material processes in which the special features of the first process are reproduced in corresponding features of the other. However, a simulation process in an organism is achieved not by means of passive reflection, but through a directed-search activity, i. e., through active selection of information. The selection of information for the construction of the necessary strategy and tactics of behavior makes it possible to act "intelligently." The simulating character of reflection activity in the course of sensory perception has been proved experimentally by psychologists and physiologists. Cybernetics, according to V. M. Glushkov, considers the human brain as a universal instrument of "dynamic information simulation." Simulation is based on the formal resemblance of a known analogy between qualitatively different processes. Therefore, generally speaking, a model can be defined as a system having a similarity to another system within the limits of one or several information codes.

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ACC NR: AP5016845

The most essential features (invariants), which are always present in the simulated object, must be reflected in the model. At the present time there is no doubt that, in principle, any form of human thinking can be simulated in an information plane by means of cybernetic systems.

Some Principles of Brain Activity

The operation of the brain as a simulating device is based on the following principles:

- 1) Succession. The formation of models results from the "processing" of the information, i. e., recoding it from a lower to a higher code. In speech simulation, the succession of codes will be : code of sounds, code of words, code of sentences, code of meanings.
- 2) "Active" isomorphism. The formation of a model proceeds according to the laws of isomorphic representation. A model is an ideal form characteristic for reflection processes in human beings and animals.

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ACC NR: AT6016845

- 3) Comparability. The formation of new models proceeds by comparing existing or newly created models with those newly appearing due to the arrival of signals to the brain.
- 4) The "functional ring." Simulation proceeds in a definite material substratum—nerve structures. Simulation should be considered the result of the circulation of information in an integral closed system: skin—subcutaneous devices—center—periphery..
- 5) Entropy. Entropy is a measure of chaos (disorder), and information is a measure of order. The creation of a model in the brain leads to a decrease in entropy. When information enters the brain, order increases and uncertainty decreases.
- 6) Expectancy probability. The presence of a feedback, a channel through which signals from the periphery flow into the brain, has meaning when it is possible to compare in the brain what was done with what should happen as a result of the action. P. K. Anokhin refers to an "acceptor of action" which should be found in the brain.

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ACC NR: A16016845

7) Minimization of the negative afferent. An organism selects the strategy of behavior which offers to satisfy vital needs and to make it possible to avoid unfavorable situations and negative emotions.

All these principles should be exploited in modeling psychic functions on electronic computers.

The processing of information in the brain proceeds according to two programs: the intellectual (logical) and the emotional. The formation of the intellectual program in a human being is based on the rules of logic developed in the course of study. The emotional program reflects the organic and social needs of a man, and is a necessary component of a logical process.

A number of attempts at simulating personality have been made. The "Oldos" personality was developed in the west. The model suggested by the authors, which they feel is superior to "Oldos," is based on universally recognized concepts regarding emotions considered as the reactions of systems directed toward the satisfaction of the personal and social needs of an organism and which are determined by the state of temporary linkages.

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ACC NR: AP6016845

The Model and Its Teacher

Figures 1 and 2 show how the personality model will operate. A question arrives at the entrance unit. It is assumed that each question contains not only "meaningful" but also "emotional" information. The information is made up of words, word order, and intonation. At the entrance unit, the question is separated into two parts: words and "emotions." This is necessary for the separate fulfillment of logical and "emotional" programs. Words for answering the entering question are selected from a specially organized memory. The memory unit consists of two parts: associative and address. The associative part contains a list of words for answering the standard assembly of questions. The address portion contains a limited dictionary of the model and indicated mutual associations—linkages between words. The list of words on the basis of which the reaction of the model will be constructed is forwarded to the answer unit. In this model, the operations of forecasting the results are distributed to separate units.

In the answer unit, the structure of the answer is filled with words from the assembly, which fit for the given conditions. The formation includes words used mostly in the personality "lexicon,"

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ACC NR: AP6016845

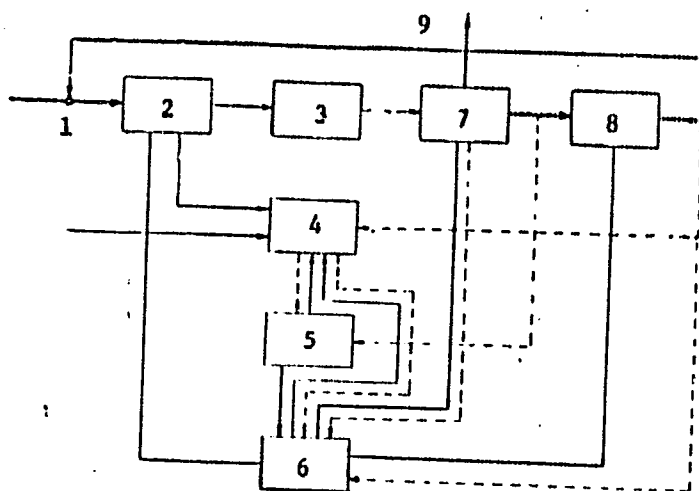
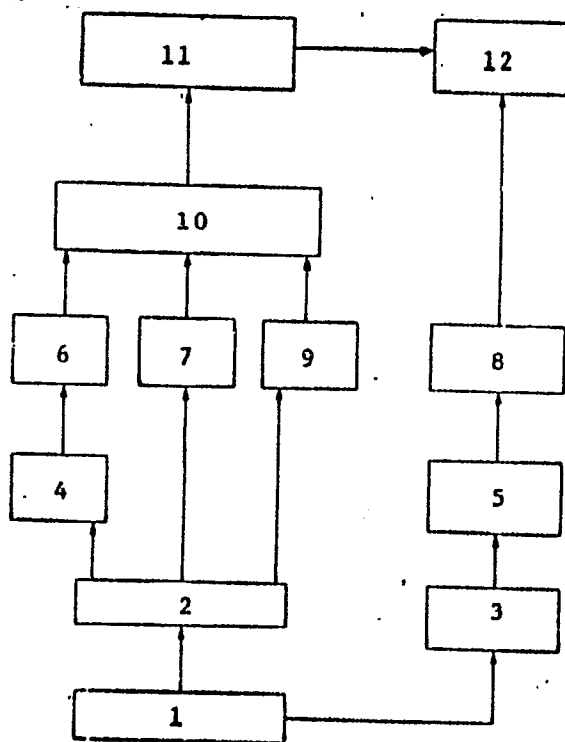


Fig. 1. Diagram of a model answering questions with regard to its own "emotional" state

1 - Question; 2 - entrance unit; 3 - interaction unit; 4 - emotion unit; 5 - short memory unit; 6 - long memory unit; 7 - answer unit; 8 - analysis unit; 9 - answer.

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ACC NR: AP6016845



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ACC NR: AP6016845

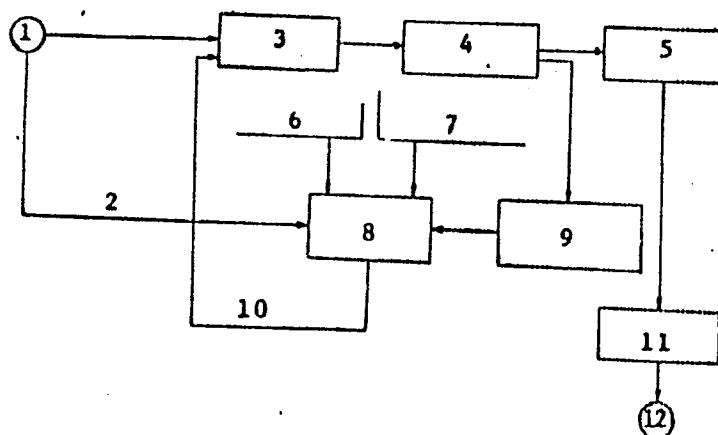


Fig. 2. Diagram for the searching of information and the developing of emotional state

1 - Beginning; 2 - emotional evaluation of question; 3 - search by emotional indication; 4 - search by identification sign; 5 - selection of answer dictionaries; 6 - emotional background; 7 - emotional evaluation of the previous answer; 8 - emotion unit; 9 - search for emotional in-

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ACC NR: AP6016845

dications of sections containing the same question; 10 - corrected emotional evaluation; 11 - determination of the total part; 12 - end.

Fig. 3. Diagram for the construction of the answer to the question presented

1 - Dictionary of the answer; 2 - selection of words; 3 - selection of associative pairs; 4 - calculation of semantic coefficient; 5 - calculation of the weight of the pair; 6 - checking of coefficient value; 7 - calculation of emotional coefficient; 8 - determination of the associative chair; 9 - calculation of frequency coefficient; 10 - calculation of the total coefficient; 11 - filling the construction; 12 - expanding the construction.

words with the most ponderous emotional significance and those which are most closely associated with the content of the answer (Fig. 3). The answer is then expanded by means of associations.

Once an answer has been developed, it must be analyzed. Analysis represents the highest stage of the model. Analysis takes two directions: the emotional and the logical. Following analysis of the structure, recommendations are developed for execution of the subse-

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ACC NR: AP6016845

quent operations: 1) Changing the answer structure through expansion or reduction, and repetition of the entire cycle for the derivation of the answer. 2) Changing the logical conditions of the operation according to the interaction of emotions. 3) Recording the answer in a long-lasting memory.

The above outlined analysis program makes it possible to expose errors in the answer, to change the inner program of the model in the proper direction, to solve the problem of the memorization of freshly formed associative pairs of the answer, etc. At this point the whole cycle of the model's operation ends, [FSB: v. 3, no. 1]

SUB CODE: 06,09 / SUBM DATE: none / ORIG REF: 002 / OTH REF: 001

Card 11/11

IVANOV-MUROMSKIY, Kirill Aleksandrovich [Ivanov-Muroms'kyi, K.O.]

[Sleeping brain] Spliachyi mozok. Kyiv, Naukova dumka,
1964. 77 p. (MIRA 18:2)

GOLOVAN', Emiliy Timofeyevich [Holovan', E.T.]; STARINETS, Valeriy
Sergeyevich [Starynets', V.S.]; IVANOV-MURCMSKIY, Kirill
Aleksandrovich; MOTRUK, R.I., red.

[Machine penetrates into the mysteries of the brain; modeling
of emotions] Mashyna pronikaie v taiemnytsi rozku; modeliuvan-
nia emotsii. Kyiv, Naukova dumka, 1965. 127 p.

(MIRA 19:1)

YEL'MEYEV, V.Ya., prepodavatel'; IVANOV-OMSKIY, I.I., prepodavatel'; KAZAKOV, A.P., prepodavatel'; NOVOZHILOVA, L.I., prepodavatel'; DROZDOV, A.V., prepodavatel'; KORNEYEV, M.Ya., prepodavatel'; BELYKH, A.K., prepodavatel'; YADOV, V.A., prepodavatel'; ROZHIN, V.P., prof., otv. red.; MIKHLIN, Ye.I., red.; VODOLAGINA, S.D., tekhn. red.

[Base and superstructure of a socialist society] *Bazis i nadstroika sotsialisticheskogo obshchestva.* Leningrad, Izd-vo Leningr. univ., 1961. 168 p.
(MIRA 14:9)

1. Leningrad. Universitet. 2. Filosofskiy fakul'tet Leningradskogo gosudarstvennogo universiteta (for all except Rozhin, Mikhlin, Vodolagina)

(Economics)

IVANOV-OMSKIY, V.I.; KOLOMIYETS, B.T.

Some properties of the alloy InSb-GaSb. Fiz. tver. tela 1 no. 4:
568-569 '59. (MIRA 12:6)
(Indium-antimony-gallium alloys)

IVANOV-OMSKIY, V.I.; KOLOMIYETS, B.T.

Equilibrium solid solutions in the system InSb - GaSb. - GaSb.
Fiz. tver. tela 1 no.6:913-918 Jo '59. (MIRA 12:10)

1. Leningradskiy fiziko-tekhnicheskoy institut AN SSSR,
(Indium antimonide) (Gallium antimonide)

5(4)

AUTHORS:

Ivanov-Omskiy, V. I., Kolomiyets, B. T.

SOV/20-127-1-36/65

TITLE:

Dependence of the Width of the Forbidden Zone on the Composition of the Solid Solution in the System InSb - GaSb (Zavisimost' shiriny zapreshchennoy zony ot sostava tverdogo rastvora v sisteme InSb - GaSb)

PERIODICAL:

Doklady Akademii nauk SSSR, 1959, Vol 127, Nr 1, pp 135-136 (USSR)

ABSTRACT:

Experiments made by other research workers on this system (Refs 2, 3) took place with InSb-GaSb alloys, whose homogeneity was not safely ascertained; hence, measuring results could not be interpreted quantitatively. Solid single-phase alloys were therefore prepared, whose homogeneity was checked by X-ray and microstructural analysis. Permeability was measured with the infrared spectrometer IKS-14. On the strength of measurements made the boundary of the absorption band was determined. Figure 1 shows that the width of the forbidden zone rises steadily but non-linearly with rising GaSb content in the alloy. Figure 2 illustrates this dependence in another connection. The ordinate is given by the wavelength corresponding to the

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Dependence of the Width of the Forbidden Zone on the Composition of the Solid Solution in the System InSb - GaSb SOV/20-127-1-36/65

boundary of the absorption band, while the abscissa is given by the GaSb per cent content. In the authors' opinion, an interpretation of the results should be deferred until the system InSb-GaSb has been more thoroughly investigated, and the structure of the energy zones of the components has been clarified. There are 2 figures and 5 references, 2 of which are Soviet.

ASSOCIATION: Fiziko-tehnicheskii institut Akademii nauk SSSR
(Physico-technical Institute of the Academy of Sciences, USSR)

PRESENTED: March 2, 1959, by A. F. Ioffe, Academician

SUBMITTED: March 23, 1959

Card 2/2

~~24 (8), 24 (3)~~ 18.7520, 18.9200

AUTHORS:

Romanenko, V. N., Ivanov-Omskiy, V. I.

66454

SOV/20-129-3-22/70

TITLE:

On the Thermodynamics of the Solid Solutions of Some Semiconductor Systems

PERIODICAL:

Doklady Akademii nauk SSSR, 1959, Vol 129, Nr 3, pp 553-555 (USSR)

ABSTRACT:

The thermodynamical investigations of the solid solutions of semiconductors may convey an impression of the character of component interaction. Such investigations are very useful for the study of some technological problems connected with the production of equilibrium solid solutions. From this point of view, the authors investigated the system Ge-Si and the quasibinary section InSb-GaSb of the triple system In-Ga-Sb. For this purpose, they compared the experimental phase diagrams with those calculated in the approximation of regular solutions by means of the equations of D. S. Kamenetskaya (Ref 1). If the displacement energies in the solid and in the liquid phase are assumed to be equal, the above-mentioned equations have the form

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On the Thermodynamics of the Solid Solutions of Some
Semiconductor Systems

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$$(x^2 - y^2)\tilde{V} - Q_A = \ln \frac{1-y}{1-x}, \quad [(1-x)^2 - (1-y)^2]\tilde{V} - Q_B = \ln \frac{y}{x}.$$

Here x and y denote the molar fractions of the difficultly meltable component in the liquid and in the solid phase respectively, \tilde{V} - the reduced displacement energy. Also for the calculation of Q_1 a formula is written down. The orders of magnitude and the sign for the displacement energy were determined from several points of the experimental diagrams. The values were more accurately fixed by the condition of the best passage of the calculated curve through the experimental points. The equations initially written down can be solved only graphically. The first figure shows the phase diagram calculated for $V = +2200$ cal/mol. The points calculated by H. Stöhr and W. Klemm (Ref 5) agree well with the liquidus- and solidus-curves determined by the authors. Interaction between the atoms Si-Si and Ge-Ge in the alloy is stronger than that on the atoms Si-Ge. The inequality $|\tilde{V}| \leq 2$ is, according to Kamenetskaya, a criterion for the production of solid solutions, and is well satisfied within this

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On the Thermodynamics of the Solid Solutions of Some
Semiconductor Systems

66454

SOV/20-129-3-22/70

temperature range. This inequality holds up to a temperature of the order of 300°C, but the solid solution is not decomposed also below this temperature. For the system InSb-GaSb, no composition-independent mixing energy agreeing well with the experimental points could be chosen. The best result was supplied by $V = +3000$ cal/mol, but also in this case not all experimental points agree well with the calculated liquidus curve. In the system InSb-GaSb, the approximation of the regular solutions will probably not be quite satisfactory. The similar components of the alloy tend to unite. In the system InSb-GaSb the solid solutions probably show a greater tendency towards separation than in the system Ge-Si. The method discussed is suited for the calculation of some thermodynamic quantities for solid substitution solutions. The authors finally thank B. T. Kolomyets and V. M. Tuchkevich for advice, and N. A. Goryunova for discussions. There are 2 figures and 7 references, 1 of which is Soviet.

Card 3/4

On the Thermodynamics of the Solid Solutions of Some
Semiconductor Systems

66454

SOV/20-129-3-22/70

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk SSSR (Physical and
Technical Institute of the Academy of Sciences, USSR)

PRESENTED: July 17, 1959, by A. F. Ioffe, Academician

SUBMITTED: July 15, 1959

Card 4/4

24.7600

81348
S/181/60/002/03/02/020
B006/B017

AUTHORS: Ivanov-Omskiy, V. I., Kolomiyets, B. T.

TITLE: Electrical Properties of the Equimolecular Alloy InSb-GaSb²¹

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 3, pp. 388-394

TEXT: The investigations described in the present paper were conducted with coarsely crystalline n-type and p-type samples produced by zonal leveling at low velocities. The n-type samples had a carrier concentration of $(1.5 - 3) \cdot 10^{15} \text{ cm}^{-3}$ and the p-type one of $(7 - 8) \cdot 10^{16} \text{ cm}^{-3}$. The samples had the shape of parallelepipeds ($12 \cdot 3.5 \cdot 1.5 \text{ mm}^3$). The temperature dependence of their conductivity (σ) and Hall coefficient (R) was measured (Fig. 1) by O. V. Yemel'yanenko's method. In the range of natural conductivity, the curves for n-type and p-type samples run parallel. The ratio between electron and hole mobility was determined from the temperature dependence of the Hall effect, and was found to be $b = \frac{u_-}{u_+} = 20$. Fig. 2 shows the results of a joint measurement of the

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Electrical Properties of the
Equimolecular Alloy InSb-GaSb

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B006/EO17

temperature dependence of σ , R , thermo-emf (α) and of the coefficients of the longitudinal (Q^{\parallel}) and transverse (Q^{\perp}) Nernst-Ettingshausen effect in an n-type sample with an electron concentration of $2 \cdot 10^{15} \text{ cm}^{-3}$. The results of the investigations were analyzed according to the individual fields. The position of the Fermi surface was directly determined from measurements of the thermo-emf, without taking into account the contribution of the holes which is estimated to be 5%. Fig. 3 shows the temperature dependence of the reduced Fermi level. A large number of data are given for the carrier mobility. The Hall mobility of the electrons changes with temperature according to the law $u_x = u_0 T^{-1.2}$, in the case of electron-phonon scattering $u \sim T^{-1.5}$ according to theory. For InSb $u \sim T^{-1.7}$ was found experimentally. The simultaneous measurement of Q^{\parallel} and Q^{\perp} at low temperatures yields a value of 1.5 for the exponent. The electron mobility measured was $35,000 \text{ cm}^2/\text{v} \cdot \text{sec}$ at room temperature; hence, $u = 0.85 \cdot u_x = 0.85 \cdot 35,000 = 30,000 \text{ cm}^2/\text{v} \cdot \text{sec}$. The hole mobility at the same temperature is found at $\approx 600 \text{ cm}^2/\text{v} \cdot \text{sec}$. The width of the forbidden zone ΔE and its temperature dependence $d\Delta E/dT$ were determined for three

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Electrical Properties of the
Equimolecular Alloy InSb-GaSb

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samples from the Hall effect as being 0.42 ± 0.02 eV (0°K), and $-(4.0 \pm 0.5) \cdot 10^{-4}$ eV/deg, respectively, according to measurements of optical absorption at 300 and 77°K . At room temperature, the width is 0.33 ± 0.01 eV. The effective carrier mass was determined by measuring the thermo-emf and the Hall effect: electron mass $(0.04 \pm 0.01)m_0$, hole mass: $(0.25 \pm 0.5)m_0$. In a Table, the results are compared with those obtained for pure InSb and GaSb. In conclusion, the authors thank L. V. Kradinova for the production of the initial materials, and O. V. Yemel'yanenko for his assistance in the measurements. There are 5 figures, 1 table, and 10 references: 4 Soviet, 2 US, 2 British, 1 Canadian, and 1 German.

ASSOCIATION: Fiziko-tekhnicheskii institut AN SSSR Leningrad (Institute of Physics and Technology of the AS USSR, Leningrad)

SUBMITTED: June 17, 1959

Card 3/3

IVANOV-OMSKIY, V. I., CAND PHYS-MATH SCI, "EQUILIBRIUM
SOLID SOLUTIONS IN THE InSb-GaSb_A ^{systems} AND THEIR ELECTRICAL PRO-
PERTIES." [LENINGRAD], 1961. (STATE ORDER OF LENIN OPTI-
CAL INST IMENI S. I. VAVILOV). (KL-DV, 11-61, 208).

-11-

24,7100 (1153, 1160, 1136)

23137
S/181/61, 103/005/042/042
B111/B202

AUTHORS: Ivanov-Omskiy, V. I., Kiseleva, N. K., and Kolomiyets, B. T.
TITLE: Production of twin crystals of indium and gallium antimonides
PERIODICAL: Fizika tverdogo tela, v. 3, no. 5, 1961, 1621-1622

TEXT: The authors attempt to produce specimens with abruptly variable parameters by growing crystal twins from two semiconductors on the basis of intergrowth. The authors suspect that this intergrowth is a sufficient condition for the isomorphism of the mentioned compound. The twin crystals were prepared in the following way: The higher melting part of the twin crystal (gallium antimonide) is cut out from one piece; the indium antimonide is pulled from the melt and grows to the gallium antimonide. To study the structure, the authors cut out specimens perpendicular to the line of separation of the two components. The surface of the cut was microscopically analyzed. The separation line between In and Ga antimonides as well as the crystal structure on both sides of the line of separation could be distinctly discerned. It was observed that in polycrystalline seeding each nucleus of the Ga antimonide forms a nucleus in the In antimonide. As could be seen

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IVANOV-OMSKIY, V.I.; KOLOMIYETS, B.T.

Thermomagnetic effects in n-type gallium antimonide and in its alloys with indium antimonide. Fiz.tver.tela 3 no.11:3553-3555 N '61. (MIRA 14:10)

1. Fiziko-tekhnicheskii institut im. A.F.Ioffe AN SSSR, Leningrad. (Thermomagnetism) (Gallium-antimony-indium alloys)

9.4177 (1635,1051)

26.2421

33373

S/18/62/004/00/05/052

B:12/B:38

AUTHORS: Ivanov-Omskiy, V. I., and Kolomiyets, B. T.

TITLE: Carrier mobility and effective electron mass in fusions of indium and gallium antimonides

PERIODICAL: Fizika tverdogo tela, v. 4, no. 1, 1962, 299 - 302

TEXT: Since low effective mass and high mobility are characteristic of $A^{III}B^V$ compounds, these parameters were chosen to study the change in structure in solid solutions of such compounds. The InSb-GaSb fusions were produced by zone leveling. The compositions 32% InSb + 68% GaSb showed an excess donor concentration of $6 \cdot 10^{15} \text{cm}^{-3}$, and 10% InSb + 90% GaSb an excess donor concentration of $7 \cdot 10^{17} \text{cm}^{-3}$. The impurity concentrations varied between 10^{14} and 10^{16}cm^{-3} . From conductivity, Hall effect and thermoelectric measurements, hole and electron mobility and electron effective mass were determined in dependence on composition. While μ remained almost independent of composition for holes, for electrons it decreased with increasing GaSb content. This curve is not far from linearity, which indicates that

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S/181/62/004/001/051/051

B112/B138

Carrier mobility and effective...

electron scattering from lattice imperfections plays a minor role in these solutions. The effective mass was calculated from thermo-emi measurements assuming electron scattering from acoustic phonons. Electron concentration was determined from the Hall effect. The following results were obtained:

InSb : GaSb in mole%	T, °K	n, cm ⁻³	m_n/m_0
100 : 0	315	$2.9 \cdot 10^{16}$	0.032
80 : 20	303	$1.05 \cdot 10^{16}$	0.035
50 : 50	277	$1.7 \cdot 10^{15}$	0.037
32 : 68	306	$6.1 \cdot 10^{15}$	0.041
10 : 90	310	$7.2 \cdot 10^{17}$	0.061
0 : 100	306	$6.2 \cdot 10^{17}$	0.22

The sudden increase in effective mass is attributed to the higher concentration of electrons and their scattering from ionized impurities. From the positive sign of both the transverse and longitudinal Nernst-Ettingshausen Card 2/3

34229

24.7700 (1035, 1043, 1055)

S/181/62/004/002/012/051
B102/B138

AUTHORS: Ivanov-Omskiy, V. I., Kolomiyets, B. T., and Chou-Huang

TITLE: Mobility and effective mass of holes in gallium antimonide

PERIODICAL: Fizika tverdogo tela, v. 4, no. 2, 1962, 383 - 387

TEXT: Hole mobility and effective mass were determined for 43 mono-crystalline GaSb specimens ($12 \cdot 3 \cdot 1.5 \text{ mm}^3$) from measurements of mobility, Hall effect and thermo-emf. The hole concentration of the specimens varied between $1.4 \cdot 10^{17}$ and $2.7 \cdot 10^{19} \text{ cm}^{-3}$. Knowing the position of the Fermi level from the thermo-emf, and the carrier concentration from Hall

effect, the carrier mass can be calculated from the relation $\left(\frac{m_p}{m_0}\right)$

$$= \left(\frac{\sqrt{\pi}}{4}\right)^{2/3} \left(\frac{h^2}{2\pi m_0 kT}\right) \left(\frac{n}{F_{1/2}(\frac{\eta}{kT})}\right)^{2/3} \cdot \bar{\eta} = \eta/kT, \eta - \text{Fermi level}, F_{1/2}(\frac{\eta}{kT})$$

$$= \int_0^\infty \frac{x^r dx}{e^{x-\eta/kT} + 1}; r \text{ is the exponent in the energy dependence of the electron}$$

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34229

Mobility and effective mass...

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and 11 non-Soviet. The four most recent references to English-language publications read as follows: D. Bolet, M. Menes. J. Appl. Phys., 31, 1426, 1960; C. Hilsum, Proc. Phys. Soc., 76, 414, 1960; L. R. Weisberg, J. B. Blanck, Bull. Am. Phys. Soc. 5, 62, 1960; T. S. Moss. Optical properties of Semiconductors. London, 1959.

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR
Leningrad (Physicotechnical Institute imeni A. F. Ioffe
AS USSR, Leningrad)

SUBMITTED: August 10, 1961

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Card 3/3

Electrical properties of monocrystalline HgTe and its alloys with CdTe.
V. I. Ivanov-Omskiy, B. T. Kolomiyets, A. A. Mal'kova, V. K. Ozorodnikov,
K. P. Smekalova. (Presented by V. I. Ivanov-Omskiy--15 minutes).

Notes: HgTe in semi-metallic; at 4°K the band overlap is ~ 0.05 eV,
 $\mu_h/\mu_e = 50$ to 100.

Report presented at the 3rd National Conference on Semiconductor Compounds,
Kishinev, 16-21 Sept 1963

3. Investigations of the solid solutions of the antimonides of indium and gallium. I. S. Baukin, V. I. Ivanov-Omskiy, B. T. Kolomiets.

Report presented at the 3rd National Conference on Semiconductor Compounds, Kishinev, 16-21 Sept 1963.

ACCESSION NR: AP4034929

S/0181/64/006/005/1457/1461

AUTHOR: Ivanov-Omskiy, V. I.; Kolomiyets, B. T.; Mal'kova, A. A.

TITLE: Optical and photoelectric properties of HgTe, and its alloys with CdTe

SOURCE: Fizika tverdogo tela, v. 6, no. 5, 1964, 1457-1461

TOPIC TAGS: HgTe, HgTe--CdTe alloys, optical properties, photoelectric properties, photosensitivity

ABSTRACT: The nature of the photosensitivity of HgTe and of Cd Hg_{1-x}Te specimens is discussed on the basis of measurements of their optical and photoconductive properties. Experiments were conducted with p-type specimens with an acceptor concentration of 10^{17} — 10^{18} cm³ [sic] [10^{17} — 10^{18} cm⁻³]. Transmission and reflection were measured at 150 and 300C at 1—25μ on the IKS-12 spectrometer with the IPO-12 attachment, and the absorption coefficients were determined from the data obtained. The photoconductive properties

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ACCESSION NR: AP4034929

were studied with equipment described by B. T. Kolomiets and A. A. Mal'kov (FTT, 5, 1219, 1963). The photomagnetic effect was measured in magnetic fields of 500—20,000 oe, and the photoconductivity in electric fields of 5—15 v/cm. The experimental results are given in the text. Optical data indicate that specimens with a low HgTe content ($x > 0.2$) are semiconductors, and those with a high HgTe content are semimetals. The photosensitivity of the specimens has a complex nature. In HgTe and in its alloys with a high HgTe content ($x < 0.2$) the photosensitivity is caused by the Narust effect; the bolometric effect is insignificant. Photoconductivity and the Kikoin-Noskov effect appear with an increase in the CdTe content; they prevail in specimens with $x > 0.25$. Thus, specimens with a high HgTe content are semiconductors whose band width decreases with an increase in the HgTe content. The optical and semiconductive properties of alloys with a high HgTe content can be explained by the semimetallic nature of the conductivity. Orig. art. has 2 formulas and 3 figures.

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ACCESSION NR. AP4034929

ASSOCIATION: Fiziko-tekhnicheskii institut imeni A. F. Ioffe, AN SSSR,
Leningrad (Physisotechnical Institut, AN SSSR).

SUBMITTED: 03Dec63

DATE ACQ: 20May64

ENCL: 00

SUB CODE: PH

NO REF SOV: 003

OTHER: 005

Card 3/3

ACCESSION NR: AP4041364

S/0048/64/028/006/1000/1001

AUTHOR: Baukin, I. S.; Ivanov-Omskiy, V. I.; Kolomiyets, B. Z.

TITLE: Single crystals of indium antimonide-gallium antimonide alloy and their electrical properties

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 28, no. 6, 1964, 1000-1001

TOPIC TAGS: indium antimonide, gallium antimonide, antimonide alloy, alloy single crystal, single crystal property, electrical property

ABSTRACT: Single crystals of indium antimonide alloyed with small amounts [unspecified] of gallium antimonide have been grown by the zone-melting method using a single crystal seed. The two alloys prepared had lattice constants of 6.470 and 6.461 Å, respectively, and identical electron concentration ($3 \cdot 10^{15}$ e/cm³) and electron mobility ($98,000$ cm²/v.sec). The crystals were used to study optical absorption and reflection for wavelengths in the 6—25-μ range, and to determine the mechanism of the change of the forbidden zone width ΔE with changing alloy composition. The theoretically calculated ΔE in

Card 1/2

ACCESSION NR: AP4041377

S/0048/64/028/006/1057/1064

AUTHOR: Ivanov-Omskiy, V.I.; Kolomiets, B.T.; Mal'kova, A.A.; Ogorodnikov, V.K.; Smekalova, K.P.

TITLE: Electric properties of single crystals of p-type HgTe and its alloys with CdTe /Report*. Third Conference on Semiconductor Compounds held in Kishinev 16 to 21 Sep 1963,

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v.28, no.6, 1964, 1057-1064

TOPIC TAGS: semiconductor property, electric property, Hall constant, mercury telluride, cadmium telluride

ABSTRACT: Single crystals of HgTe and HgTe-CdTe solid solutions were prepared by Bridgman's method and annealed in mercury vapor. Electric conductivities, Hall constants, and magnetoresistances were measured, in some cases at temperatures as low as 2°K. The relation between the Hall constant of HgTe and the magnetic field was determined at 4.2°K. The relation between the Hall constant and the magnetoresistance was determined for HgTe at several temperatures and was found to be linear. The behavior of the Hall constant of HgTe at low temperatures varied from sample to

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ACCESSION NR: AP4041377

sample, and in some cases it changed sign at about 50°K. Infrared absorption coefficients and photosensitivity spectral distributions were also measured. Many of the data obtained are presented graphically. The concentration of current carriers in HgTe at low temperatures, as determined from the Hall and magnetoresistive effects, was found to be large (about $2 \times 10^{16} \text{ cm}^{-3}$ at 4.2°K) and to increase only slowly with increasing temperature. It is concluded that there can be no energy gap between the valence and conduction bands, and therefore, in agreement with Strauss et al. (A.J.Strauss, T.C.Harman, J.G.Mavroides, D.H.Dickey and M.S.Dresselhaus; Proc. Intern.Conf.Semicond.Phys.Exeter, 1962), that HgTe is a semimetal rather than a semiconductor. The data are analyzed in terms of the band structure found by Strauss et al. (Loc.cit.) for solid solutions containing 14 to 17% CdTe, and it is concluded that the V_2 valence band overlaps the conduction band by approximately 0.13 eV at 300°K. The properties of the solid solutions were found to vary continuously with composition from those of a semimetal for large HgTe concentrations to those of a semiconductor for large CdTe concentrations. The critical CdTe concentration above which the material behaved as a semiconductor was approximately 30%. The behavior of the infrared absorption, as well as that of the photosensitivity, was in agreement with this conclusion. Orig.art.has: 10 formulas, 9 figures and 1 table.

Card 2/3

ACCESSION NR: AP4041377

ASSOCIATION: none

SUBMITTED: 00

SUB CODE: SS,IC

NR REF SOV: 001

ENCL: 00

OTHER: 007

Card 3/3

"APPROVED FOR RELEASE: 08/10/2001

CIA-RDP86-00513R000619210017-4

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APPROVED FOR RELEASE: 08/10/2001

CIA-RDP86-00513R000619210017-4"

IVANOV-OMSKIY, V.I.; KOLOMIYETS, B.T.; OGRODNIKOV, V.K.; SMEKALOVA, K.P.

Electron mobility in HgTe. Dokl. AN SSSR 162 no.6:1269-1270 Je '65.

1. Fiziko-tehnicheskii institut im. A.F.Ioffe AN SSSR. Submitted (MIRA 18:7)
December 29, 1964.

"APPROVED FOR RELEASE: 08/10/2001

CIA-RDP86-00513R000619210017-4

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L 3459-66 EWT(1)/EPA(s)-2/EWT(m)/ETC/ENG(m)/EPA(w)-2/T/ENP(s)/AMP(b)/EPA(m)-2/EWA(c)
 ACCESSION NR: AP5017205 LJP(c) RLV/JD/JG UR/0020/65/162/006/1269/1270

AUTHORS: Ivanov-Omskiy, V. I.; Kolomiets, B. T.; Ogorodnikov,
 V. K.; Smekalova, K. P.; Konstantinov, B. P.

TITLE: Electron mobility in HgTe

SOURCE: AN SSSR. Doklady, v. 162, no. 6, 1965, 1269-1270

TOPIC TAGS: mercury compound, telluride, Hall coefficient, semi-conductor carrier, electron mobility, magnetoresistance

ABSTRACT: In view of the difficulty of determining the type of conductivity of HgTe from measurements of the Hall effect, owing to the larger ratio of the electron mobility to the hole mobility (~ 100), the authors investigated single-crystal samples of HgTe, prepared by zone melting with subsequent annealing in mercury vapor, over a large range of temperatures. From the temperature dependence of the Hall coefficient it is concluded that HgTe is a semiconductor of the n-type, whose carrier mobility has a temperature dependence typical of the degenerate electron gas in semiconductors and in metals. The electron

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ACCESSION NR: AP5017205

mobility is quite high at all temperatures, reaching $200,000 \text{ cm}^2/\text{V-sec}$. The Hall coefficient exhibits a strong dependence on the magnetic field intensity. This is attributed either to inhomogeneity to the crystal or to the complicated energy spectrum of the electrons in the HgTe. The magnetoresistance of HgTe is characterized by curves having a continuously varying slope and exhibiting no saturation. This report was presented by B. P. Konstantinov. Orig. art. has: 2 figures

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe Akademii nauk SSSR (Physicotechnical Institute AN SSSR)

SUBMITTED: 16Dec64

ENCL: 00

SUB CODE: *N/P*

NR REF SOV: 003

OTHER: 005

BVK
Card 2/2

L 21420-66 EWT(m)/EWP(t) IJF(c) JD
ACC NR: AP6011494

SOURCE CODE: UR/0386/66/003/007/0287/0291

AUTHOR: Ivanov-Onskiy, V. I.; Kolomiych, B. T.; Smirnov, V. A.

ORG: Physicotechnical Institute im. A. F. Ioffe, Academy of Sciences SSSR (Fiziko-
tekhnicheskiy Institut Akademii nauk SSSR)

TITLE: Spectrum of electromagnetoluminescence in InSb

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu.
Prilozheniye, v. 3, no. 7, 1966, 287-291

TOPIC TAGS: indium antimonide, radiative recombination, luminescence, spectral
distribution

ABSTRACT: The authors calculate the spectral distribution of recombination radiation caused by the magnetoconcentration effect (electromagnetoluminescence--EML) in InSb at room temperature, which they observed earlier (Dokl. AN SSSR v. 151, 1307, 1965). Recombination radiation was excited by applying a pulsed electric field to a sample of almost intrinsic p-InSb placed in a magnetic field perpendicular to the electric one. The radiation was gathered in a third mutually-perpendicular direction, guided to a monochromator, and recorded with a photoreceiver of gold-doped germanium. The pulse duration was 2--3 μ sec at a repetition frequency 2--3 cps. A pulsed synchronous detector was used to increase the

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ACC NR: AP6011494

signal/noise ratio at the output of the broadband amplifier. The spectral width of the monochromator slit was 0.3μ at a wavelength of 6μ . The oscillograms of the sample-current and photoreceiver signal pulses show that the observed signal has a very low rise time (of the order of $0.2-0.3 \mu\text{sec}$), so that the observed signal can be ascribed to electroluminescence. EML spectra of p-InSb with acceptor density $5 \times 10^{18} \text{ cm}^{-3}$ for different intensities of the electric and magnetic fields E and H show that, with increasing product $E \times H$, which determines the concentration of the excess carriers on the crystal face from which the radiation is observed, the maximum of the emission intensity shifts markedly toward the short-wave part of the spectrum, and the spectral-band shape and width are simultaneously changed. This shift can be connected with the appreciable increase of the concentration of the excess carriers, which fill noticeably the bottom of the conduction band. The shift of the maximum and the broadening of the spectral band may be due, in addition, to heating of the electron gas under the influence of the electric field, but this heating of the electron gas cannot influence noticeably the spectral distribution of the radiation. It is also noted that in the analysis of EML spectra it is necessary to take into account the principal inhomogeneity in the distribution of the carriers. The difficulties entailed in simultaneous account of all the foregoing circumstances does not permit at present an exact estimate

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